

## 8.6 CAROLINE COUNTY

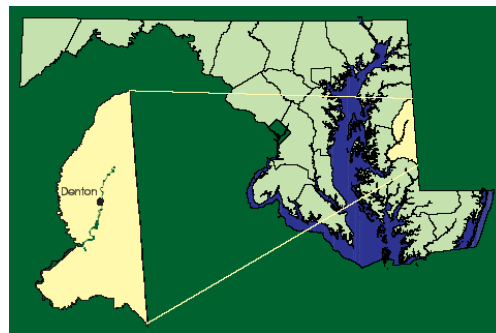
This chapter presents information about stream conditions of potential management interest in Caroline County based on the 2000-2004 Maryland Biological Stream Survey (MBSS) results. Information from MBSS data collected between 1994 and 1997 can be found in MDNR 2001f.

### 8.6.1 Ecological Health

Based on the three ecological health indicators used by the MBSS, the overall condition of Caroline County streams during 2000-2004 was Fair-Poor (Figure 8-51). The FIBI indicate that 13% of the streams in the county were in Good condition, and the BIBI indicated that about 15% were rated as Good. About 39% of the streams in the county scored as Poor or Very Poor using the BIBI, while 41% were scored in those categories using the FIBI. Nearly 21% of Caroline County stream miles were not rated using the FIBI. Streams that were not rated had chemical characteristics of blackwater streams or were dry and unsampleable for fish. Because of the difficulty in finding reasonable reference conditions in these highly disturbed watersheds, sites with Poor or Very Poor FIBI scores are considered 'Not Rated' and not included in stream mile estimates of FIBI condition. Using the Combined Biotic Index (CBI), 67% of the streams scored as Poor or Very Poor, 15% scored as Good, and 19% scored as Fair.

There was no apparent geographic trend in IBI scores in Caroline County. The highest rated stream using the Combined Biotic Index (CBI) was Watts Creek, while the lowest rated streams included an unnamed tributary to Tidy Island Creek, an unnamed tributary to the Choptank River, and Mason Branch (Table 8-15). Based on Stream Waders volunteer data, the Upper Choptank watershed had the largest number of sites rated as Poor or Very Poor for benthic macroinvertebrates (Table 8-16).

One current and one former MBSS Sentinel site are located in Caroline County. The former site is Skeleton Creek, and the current site is an unnamed tributary to the Choptank River. Sentinel sites were chosen to provide a representation of the best remaining streams around the state and track natural variations in stream health. Where possible, Sentinel sites are located in watersheds with as much protected land as possible, or in areas projected to become degraded from development at a slower pace. In the case of Skeleton Creek, the site was dropped from the network because of lowering Combined Biotic Index scores. More information about the MBSS Sentinel stream network is found in: 2000-2004 Maryland Biological Stream Survey Volume 11: Sentinel Sites ([http://www.dnr/Maryland.gov/streams/pubs/ea05-8\\_sentinel.pdf](http://www.dnr/Maryland.gov/streams/pubs/ea05-8_sentinel.pdf)).



### 8.6.2 Physical Habitat

#### 8.6.2.1 Overall Condition

Based on the Physical Habitat Index (PHI), 21% of the streams in Caroline County had Minimally Degraded habitat, and 21% had Degraded or Severely Degraded habitat (Figure 8-52). The remaining proportion of stream miles (43%) was rated as Partially Degraded. There was no apparent geographic trend in physical habitat in the county.

#### 8.6.2.2 Trash

Caroline County streams generally have little human refuse in and near them. Approximately 79% of the stream miles were rated Optimal for trash (Figure 8-53). In contrast, 13% were rated as being in Marginal condition, and none were rated as Poor. There was no apparent geographic trend in trash levels along streams in the county.

#### 8.6.2.3 Channelization

Over one half of the stream miles in Caroline County were channelized (Table 8-4). All of the documented channelization was in the form of earthen ditches. There was no strong pattern in the distribution of ditched streams (Figure 8-54).

#### 8.6.2.4 Inadequate Riparian Buffer

Only 2% of the stream miles in Caroline County had no effective riparian buffers. In addition, 4% of stream miles had severe breaks in the buffers that were recorded. There was no apparent geographic trend in the distribution of sites with no buffer or buffer breaks in Caroline County (Figure 8-55). Additional information about buffer breaks, analyzed by county, is provided in: 2000-2004 Maryland Biological Stream Survey Volume 10: Riparian Zone Conditions ([http://www.dnr/Maryland.gov/streams/pubs/ea05-7\\_riparian.pdf](http://www.dnr/Maryland.gov/streams/pubs/ea05-7_riparian.pdf)).

### 8.6.2.5 Eroded Banks/Bedload Movement

An estimated 73% of the stream miles in Caroline County had minimal (rated as Optimal) amounts of bank erosion (Figure 8-56). In contrast, 5% of the streams had large amounts of bank erosion (rated as Poor), and an additional 10% were rated Marginal. Bank erosion problems were greatest in the northern portion of the county.

Only 8% of the stream miles in Caroline County had extensive formation of instream bars (Figure 8-56). An additional 16% had moderate bar formation, and more than 75% had minor bar formation. No streams sampled were devoid of bars. Bar formation appeared to be slightly more extensive around the Town of Denton compared to other areas.

### 8.6.3 Key Nutrients

#### 8.6.3.1 Nitrate-Nitrogen

About 19% of the stream miles in Caroline County had nitrate-nitrogen levels at or below levels observed in mostly forested streams within Maryland (Figure 8-57). An additional 31% had levels above 5 mg/l, the threshold beyond which impacts to stream biota have been documented. The remaining 50% of stream miles had levels above background but less than 5 mg/l. There was no apparent geographic trend in the distribution of nitrate-nitrogen in the county.

#### 8.6.3.2 Total Phosphorus

Nearly 15% of the stream miles in Caroline County had total phosphorus levels above the threshold associated with biological impairment (Figure 8-58). An additional 60% of stream miles had levels above those observed in forested Maryland streams. Only 25% of the stream miles in the county had total phosphorus levels at or below background. Similar to nitrate-nitrogen, there was no apparent geographic trend in the distribution of total phosphorus within the county.

### 8.6.4 Stream and River Biodiversity

To provide a means to prioritize stream systems for biodiversity protection and restoration within each county and on a statewide basis, a tiered watershed and stream reach prioritization method was developed. Special emphasis was placed on state-listed species, stronghold watersheds for state-listed species, and stream reaches with one or more state-listed aquatic fauna. Fauna considered

included stream salamanders, freshwater fishes, and freshwater mussels. Rare, pollution-sensitive benthic macroinvertebrates collected during the 1994-2004 MBSS were also used to identify the suite of watersheds necessary to conserve the full array of known stream and river biota in Maryland. A complete description of the biodiversity ranking process is found in: 2000-2004 Maryland Biological Stream Survey Volume 9: Stream and Riverine Biodiversity ([http://www/dnr/Maryland.gov/streams/pubs/ea05-6\\_biodiv.pdf](http://www/dnr/Maryland.gov/streams/pubs/ea05-6_biodiv.pdf)).

Of the four watersheds found in Caroline County, the highest rated for stream and river biodiversity was Tuckahoe Creek, a Tier 1 watershed that was a stronghold watershed for one or more state-listed species (Figure 8-59). The other Tier 1 watershed in the county was the Upper Choptank River. In contrast, the Honga River/Little Choptank River/Lower Choptank River watershed was the lowest ranking for stream and river biodiversity in the county, and ranked 61<sup>st</sup> of 84 in Maryland. Any reaches that had either state-listed species or high intactness values were highlighted to facilitate additional emphasis in planning restoration and protection activities.

### 8.6.5 Stressors

At 72% of stream miles, the most extensive stressor characterized by the MBSS in Caroline County during the 2000-2004 MBSS was non-native terrestrial plants in the riparian zone (Figure 8-5). Other stressors found extensively were: streams with non-native aquatic fauna (present in 46% of stream miles); channelized streams (56% of stream miles); low dissolved oxygen (26% of stream miles); high nitrate-nitrogen levels (50% of stream

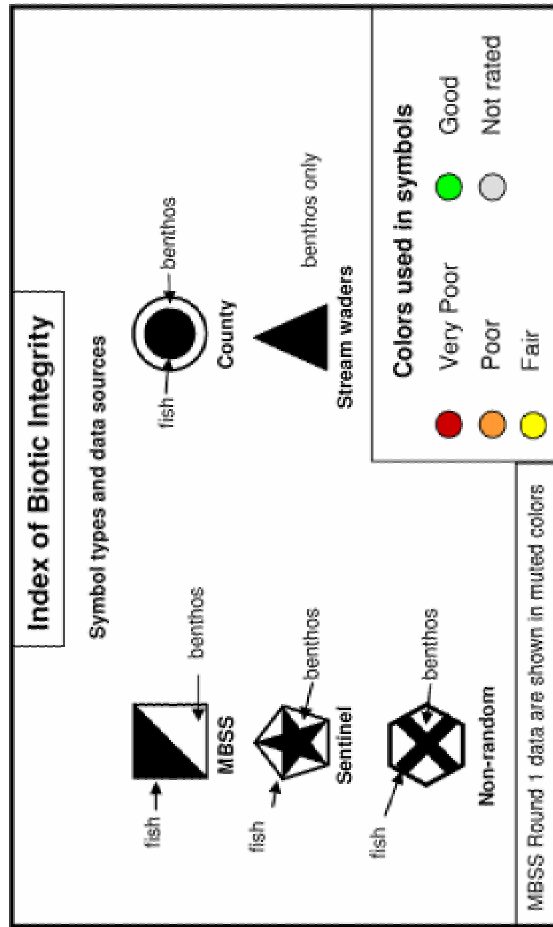
#### AN IMPORTANT NOTE ON BIODIVERSITY MANAGEMENT

Perhaps the largest ongoing natural resources restoration and protection effort in Maryland is associated with the Chesapeake Bay. In most cases, freshwater biodiversity is not specifically considered during placement and prioritization of Bay restoration and protection projects. In this report and in the more detailed volume in the series on aquatic biodiversity, a system of biodiversity ranking is presented to provide counties and other stewards with a means to plan appropriate protection and restoration activities in locations where they would most benefit stream and river species. Given the historically low level of funding for biodiversity protection and restoration in Maryland and elsewhere, the potential benefit of incorporating freshwater biodiversity needs into other efforts is quite large.

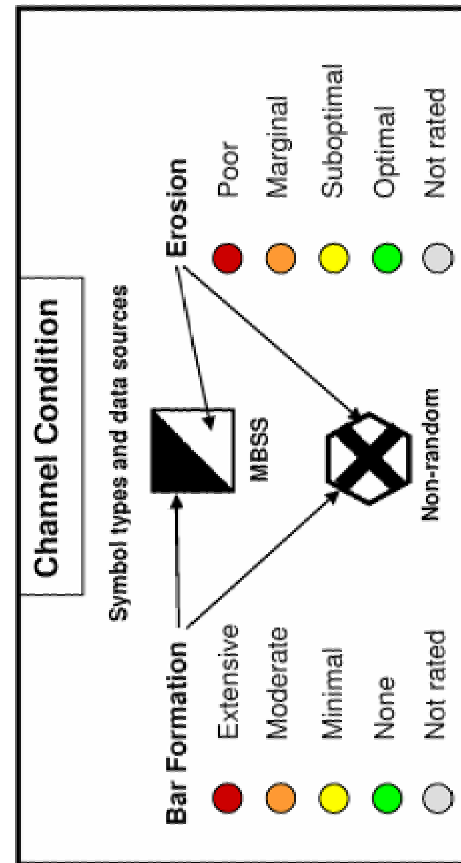
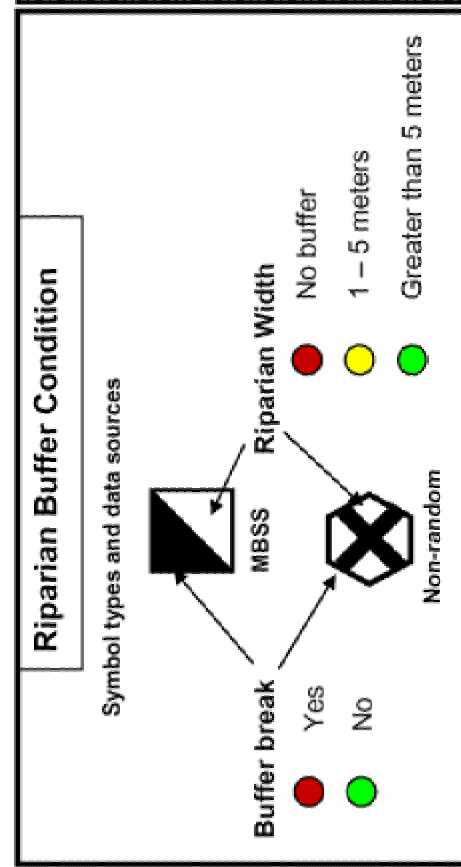
However, it is important to note that although freshwater taxa are the most imperiled group of organisms in Maryland, other groups and individual species not typically found in freshwater habitats are also at high risk and constitute high priority targets for conservation. In addition, freshwater taxa that prefer habitats such as small wetlands may not be well-characterized by the ranking system employed here. To conserve the full array of Maryland's flora and fauna, it is clearly necessary to use other, landscape-based tools and consider factors such as maintaining or reconnecting terrestrial travel corridors.

miles) eroded banks (17% of stream miles); acid deposition (observed in 8% of stream miles); streams with > 5% urban land use (4% of stream miles); and areas with no riparian buffer (2% of stream miles).

# Key to MBSS 2000-2004 County Maps



- Tier 1: Stronghold watershed (most robust remaining population) for one or more state-listed fish, aquatic herpetofauna, or freshwater mussels.
- Tier 2: Stronghold watershed for one or more non-state listed species of greatest conservation need (GCN) fish, aquatic herpetofauna, or freshwater mussels, that also had state-listed fish, aquatic herpetofauna, or freshwater mussels present.
- Tier 3: Stronghold watershed for one or more non-state listed GCN fish, aquatic herpetofauna, or freshwater mussels, no state-listed fish, aquatic herpetofauna, or freshwater mussels present.
- Tier 4: Non-stronghold watershed with one or more state-listed fish, aquatic herpetofauna, or freshwater mussels present.
- Tier 5: Not of the above, but a biodiversity conservation watershed. In other words, part of the network of watersheds that must be conserved to keep all native fishes, aquatic herpetofauna, freshwater mussels, and rare, pollution sensitive benthic macroinvertebrates extant in Maryland.
- Tier 6: Not of the above.



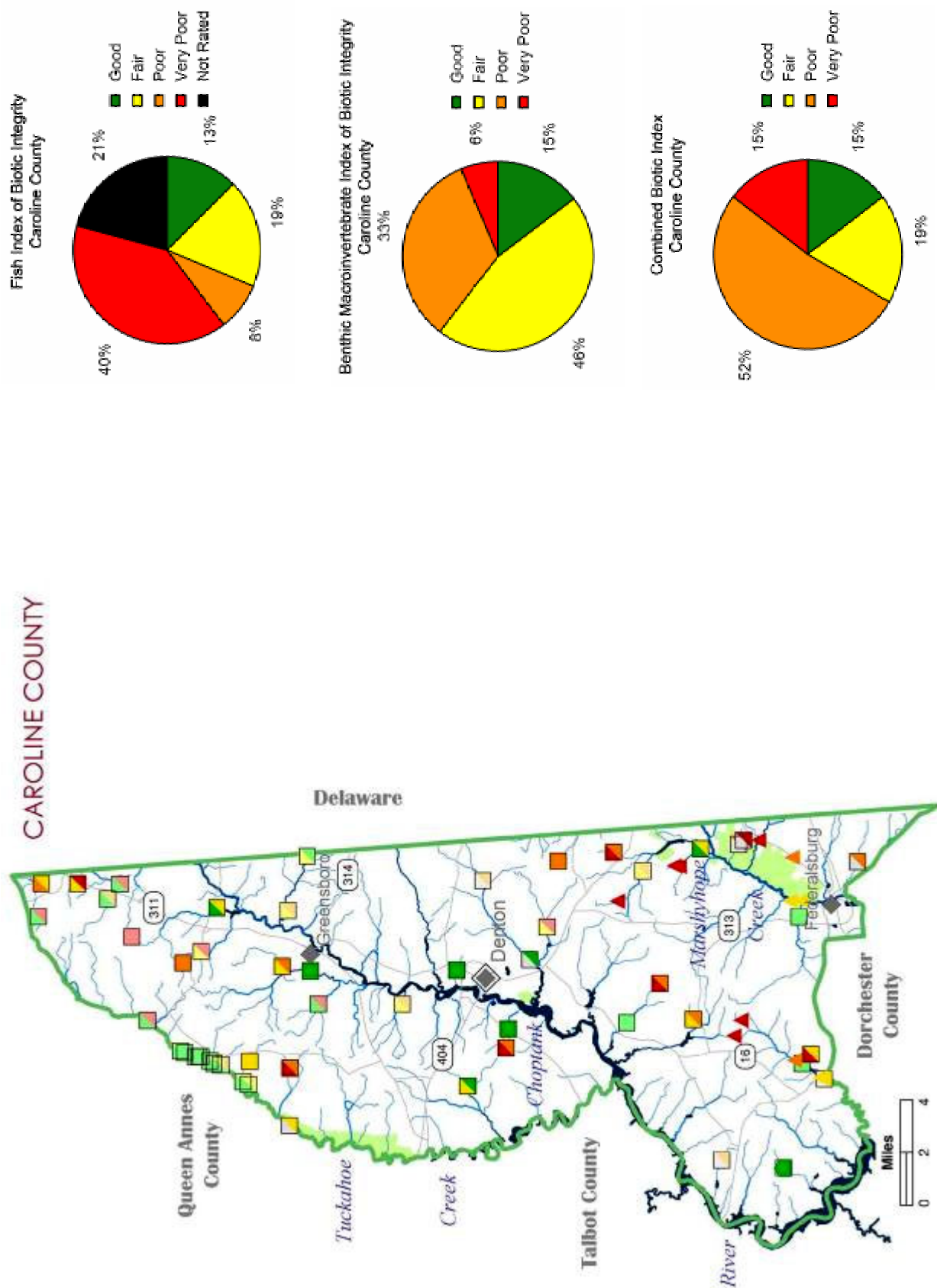


Figure 8-51. Benthic Index of Biotic Integrity (BIBI) and Fish Index of Biotic Integrity (FIBI) pie charts and map of stream health for Caroline County streams sampled by the MBSS during 1995-97 and 2000-2004 (pie charts represent 2000-2004 data only, Combined Biotic Index pie chart represents mean of FIBI and BIBI)

Table 8-15. MBSS sites sampled in Caroline County during 1994- 2004, ranked by Combined Biotic Index Score (CBI)

Caroline County - MBSS Sites				
SITE NUMBER	STREAM NAME	WATERSHED	CBI	
<i>Best (in order of CBI score)</i>				
UPCK-229-R-2000	Watts Creek	Choptank Upper	5.00	
QA-N-098-302-96	Mason Branch	Tuckahoe Creek	4.57	
QA-N-098-309-96	Mason Branch	Tuckahoe Creek	4.55	
CN-N-049-116-97	Robbins Branch	Choptank Upper	4.55	
UPCK-113-S-2001	Skeleton Creek	Choptank Upper	4.43	
UPCK-113-S-2003	Skeleton Creek	Choptank Upper	4.43	
UPCK-311-R-2000	Forge Branch	Choptank Upper	4.40	
CN-S-002-111-96	Hunting Creek	Choptank Lower	4.38	
UPCK-119-R-2000	Choptank River UT1	Choptank Upper	4.38	
CN-S-006-208-95	Marshyhope Creek UT	Marshyhope Creek	4.36	
UPCK-132-R-2000	Choptank River UT2	Choptank Upper	4.24	
QA-N-098-301-96	Mason Branch	Tuckahoe Creek	4.12	
UPCK-113-S-2004	Skeleton Creek	Choptank Upper	4.07	
TUCK-107-R-2003	Tuckahoe Creek UT4	Tuckahoe Creek	4.00	
UPCK-204-R-2000	Broadway Branch	Choptank Upper	3.98	
CN-N-041-205-96	Gravelly Branch	Choptank Upper	3.88	
QA-N-098-315-97	Mason Branch	Tuckahoe Creek	3.86	
TUCK-318-R-2003	Mason Branch	Tuckahoe Creek	3.86	
CN-N-024-113-96	Skeleton Creek	Choptank Upper	3.86	
MACK-218-R-2004	Marshyhope Creek UT2	Marshyhope Creek	3.79	
UPCK-113-S-2002	Skeleton Creek	Choptank Upper	3.60	
QA-N-098-308-96	Mason Branch	Tuckahoe Creek	3.52	
TUCK-101-R-2003	Mason Branch UT3	Tuckahoe Creek	3.29	
CN-N-050-102-96	Coolspring Branch	Choptank Upper	3.21	
CN-N-005-103-97	Choptank River UT	Choptank Upper	3.19	

Caroline County - MBSS Sites				
SITE NUMBER	STREAM NAME	WATERSHED	CBI	
<i>Worst (most degraded sites first)</i>				
CN-N-016-107-97	Tidy Island Creek UT	Choptank Upper	1.29	
UPCK-130-R-2000	Choptank River UT1	Choptank Upper	1.71	
TUCK-115-R-2003	Mason Branch UT4	Tuckahoe Creek	1.74	
MACK-108-R-2004	Marshyhope Creek UT1	Marshyhope Creek	1.86	
UPCK-122-R-2000	Robbins Creek UT1	Choptank Upper	1.90	
MACK-113-R-2004	Smithville Ditch	Marshyhope Creek	2.05	
UPCK-102-R-2000	Oldtown Branch UT1	Choptank Upper	2.07	
MACK-103-R-2004	Miles Branch	Marshyhope Creek	2.14	
CN-N-058-120-97	Mitchell Run	Choptank Upper	2.14	
LOCK-108-R-2003	Hunting Creek (CK) UT1	Choptank Lower	2.29	
MACK-107-R-2004	Hickman Ditch	Marshyhope Creek	2.36	
MACK-110-R-2004	Marshyhope Creek UT1	Marshyhope Creek	2.43	
CN-N-044-207-97	Burnsville Branch	Choptank Upper	2.43	
CN-N-039-108-96	Beaverdam Ditch UT	Choptank Upper	2.50	
CN-N-046-105-97	Oldtown Branch	Choptank Upper	2.60	
UPCK-115-R-2000	Tidy Island Creek UT1	Choptank Upper	2.60	
CN-N-043-102-97	Herring Run UT	Choptank Upper	2.60	
UPCK-118-R-2000	Fowling Creek UT1	Choptank Upper	2.86	
CN-N-031-122-95	Tommy Wright Branch	Marshyhope Creek	2.90	
UPCK-101-R-2000	Forge Branch UT1	Choptank Upper	2.90	
CN-N-004-311-97	Tidy Island Creek	Choptank Upper	2.93	
UPCK-109-R-2000	Harrington Beaverdam Ditch UT1	Choptank Upper	2.98	

Table 8-16. Stream Waders sites sampled in Caroline County during 2000-2004, ranked by Family-level Benthic Index of Biotic Integrity.

Caroline County - Stream Wader Sites				
WATERSHED	# GOOD	# FAIR	# POOR	# VERY POOR
Choptank Lower	0	2	1	2
Marshyhope Creek	0	2	1	4
Choptank Upper	4	13	11	33



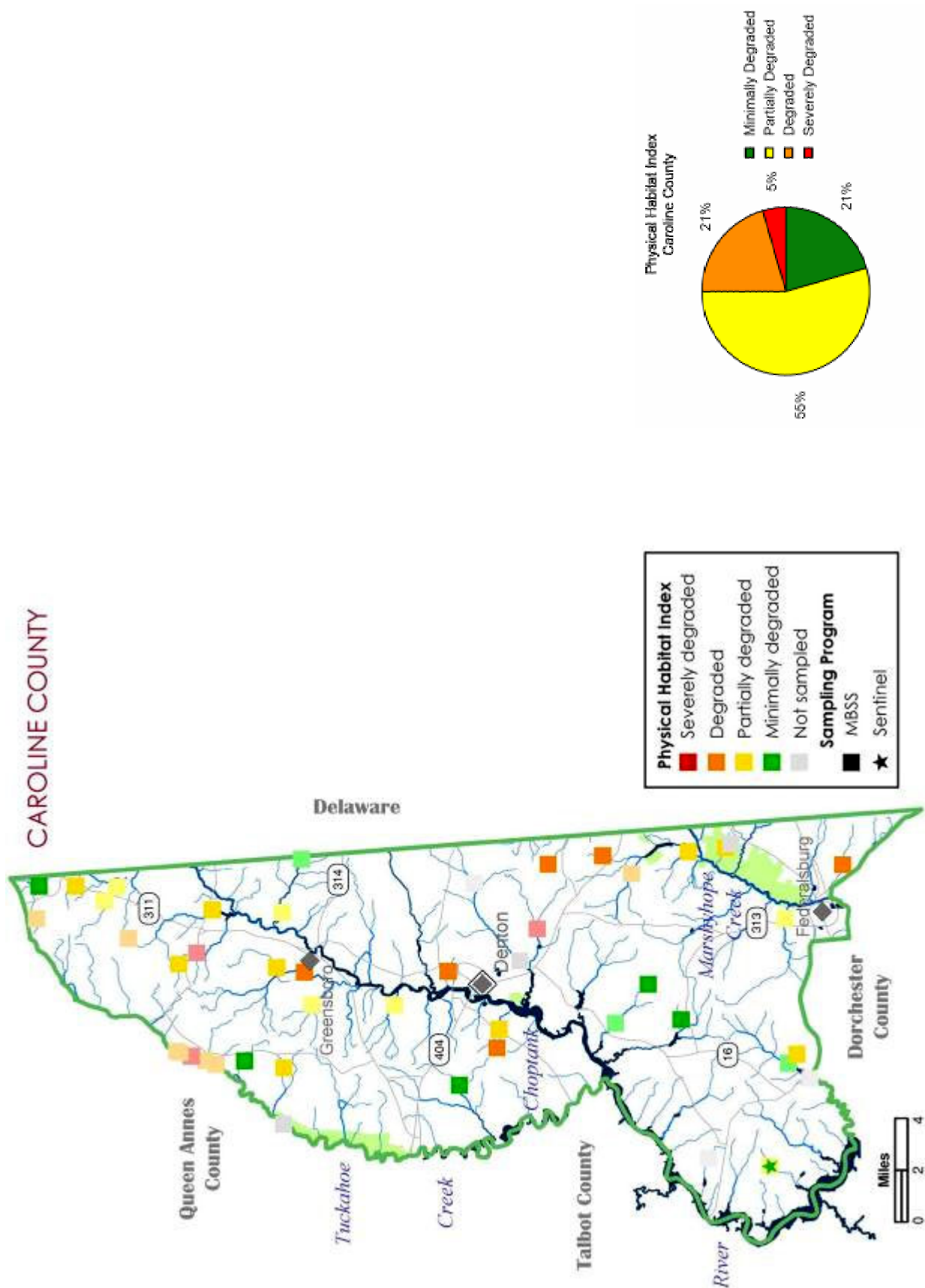


Figure 8-52. Physical Habitat Index (PHI) pie chart and map of stream habitat quality for Caroline County streams sampled by the MBSS during 1995-97 and 2000-2004 (pie chart represents 2000-2004 data only).



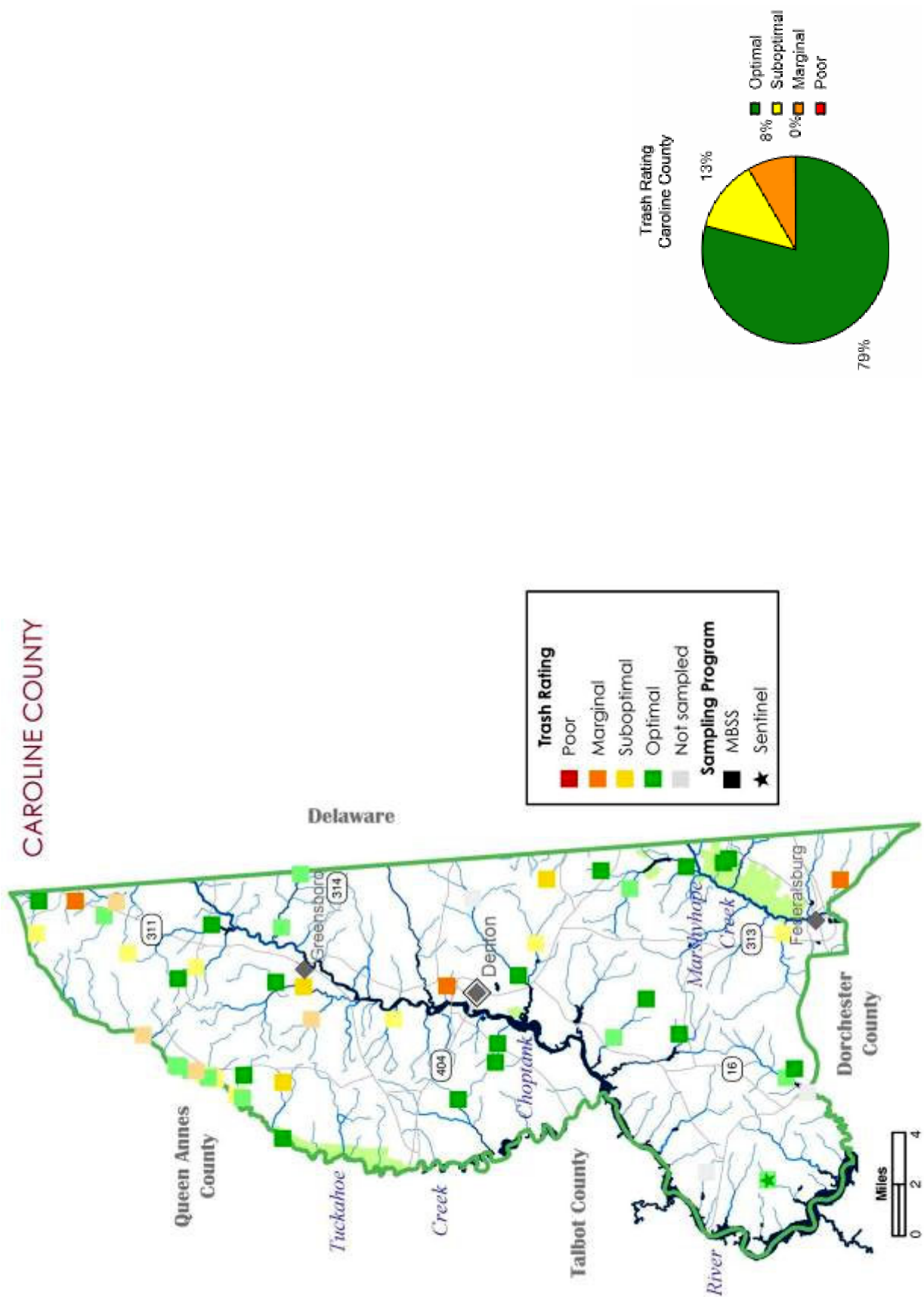


Figure 8-53. Pie chart and map of trash rating (0-20 scale) for Caroline County streams sampled by the MBSS during 1995-97 and 2000-2004 (pie chart represents 2000-2004 data only)

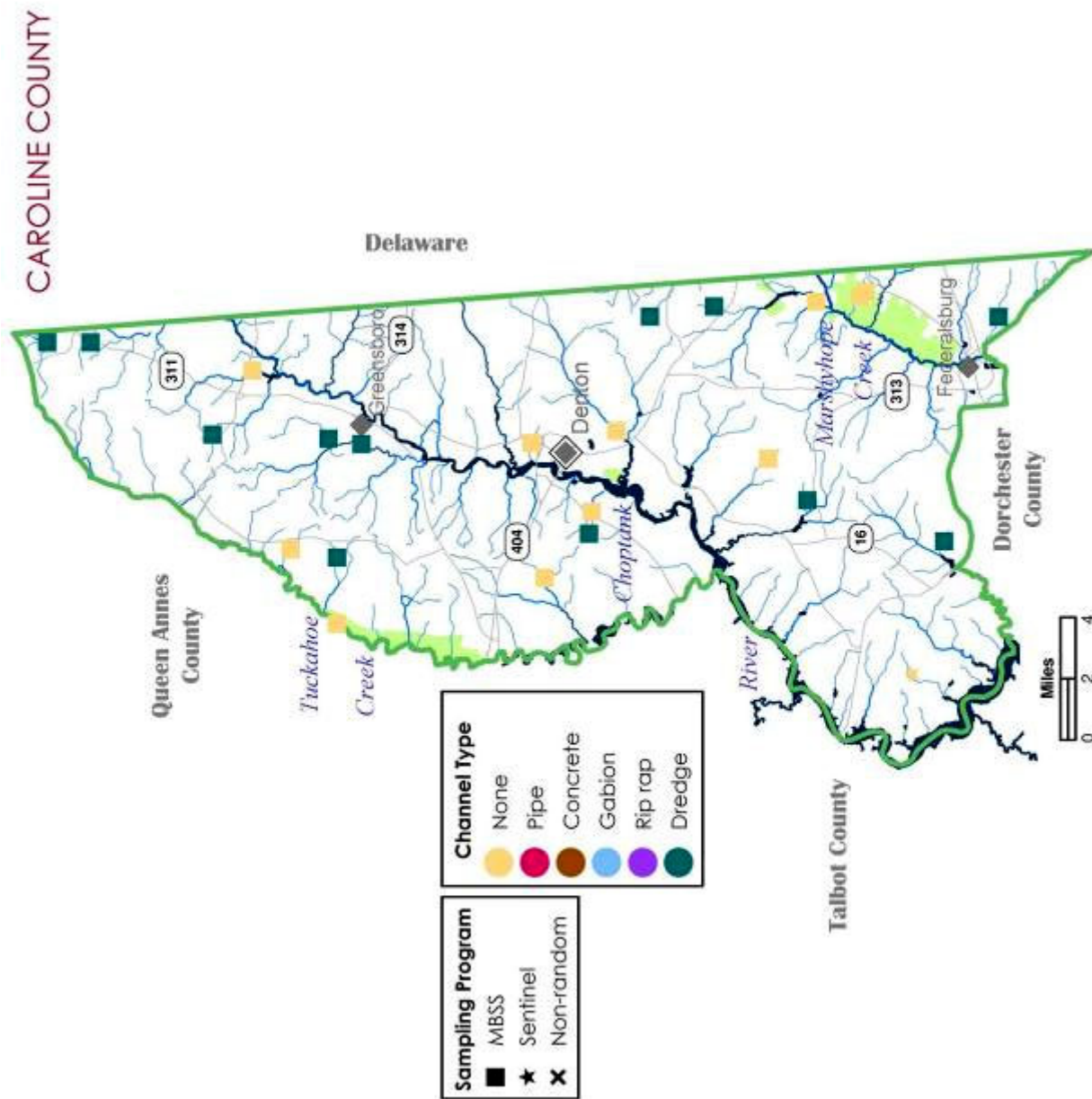


Figure 8-54. Map of channelized sites, by type, for Caroline County streams sampled by the MBSS during 2000–2004. *NOTE: When channelization is indicated, it does not necessarily mean that the entire 75m segment was affected.*

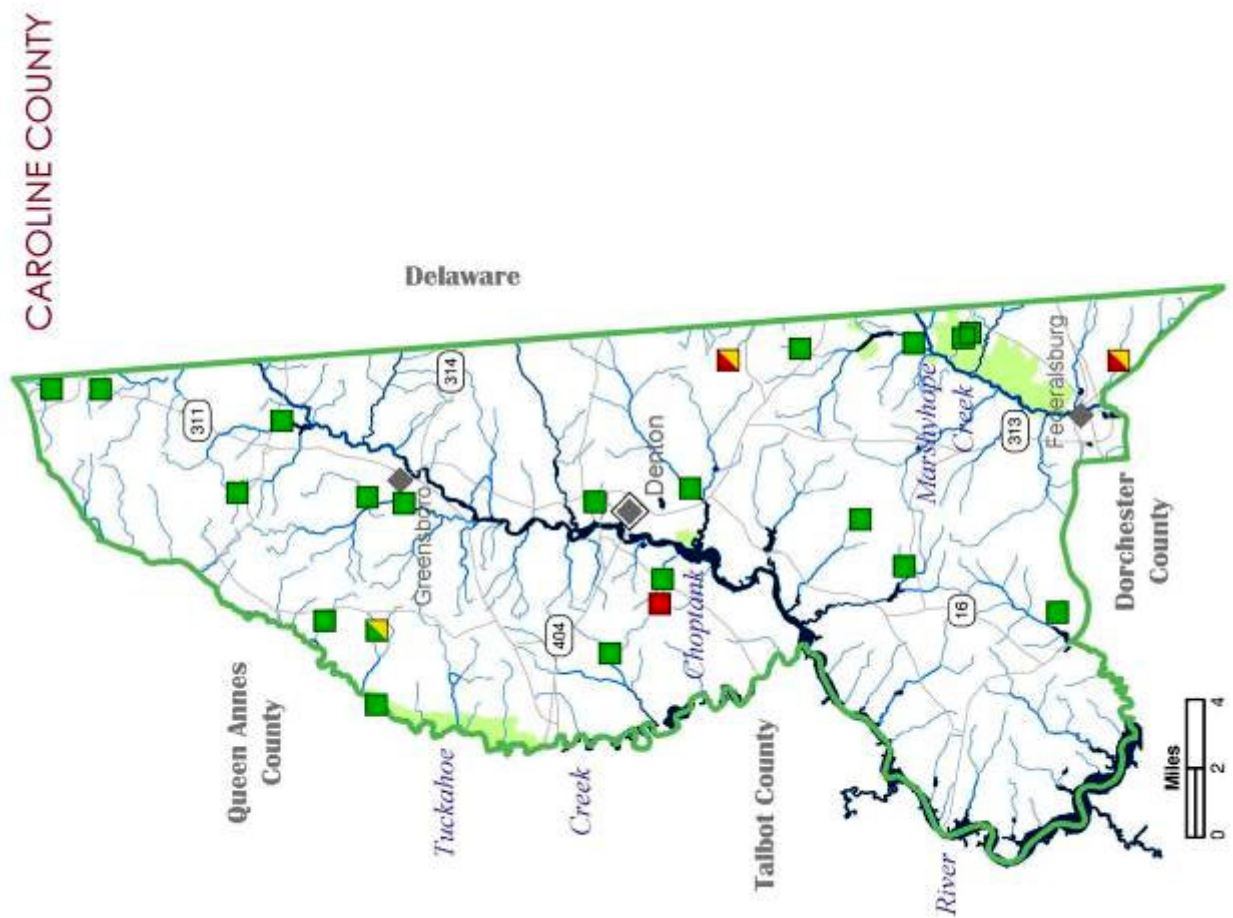


Figure 8-55. Map of sites with inadequate riparian buffers and buffer breaks for Caroline County streams sampled by the MBSS during 2000-2004. *NOTE: Multiple riparian buffer breaks sometimes occurred at a site; only the most severe was depicted.*

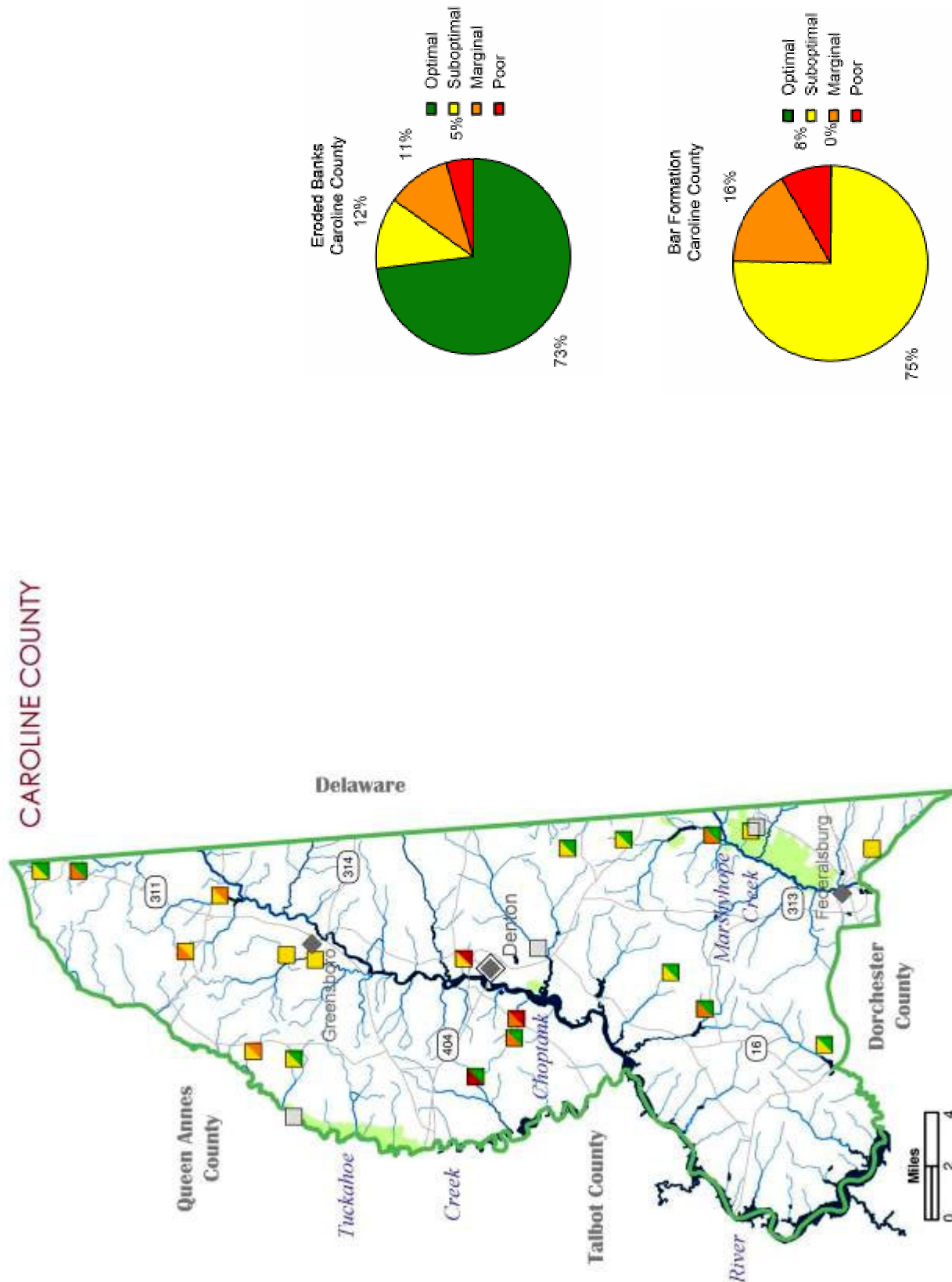


Figure 8-56. Pie charts and map of sites with eroded banks and instream bar formation for Caroline County streams sampled by the MBSS during 2000-2004.



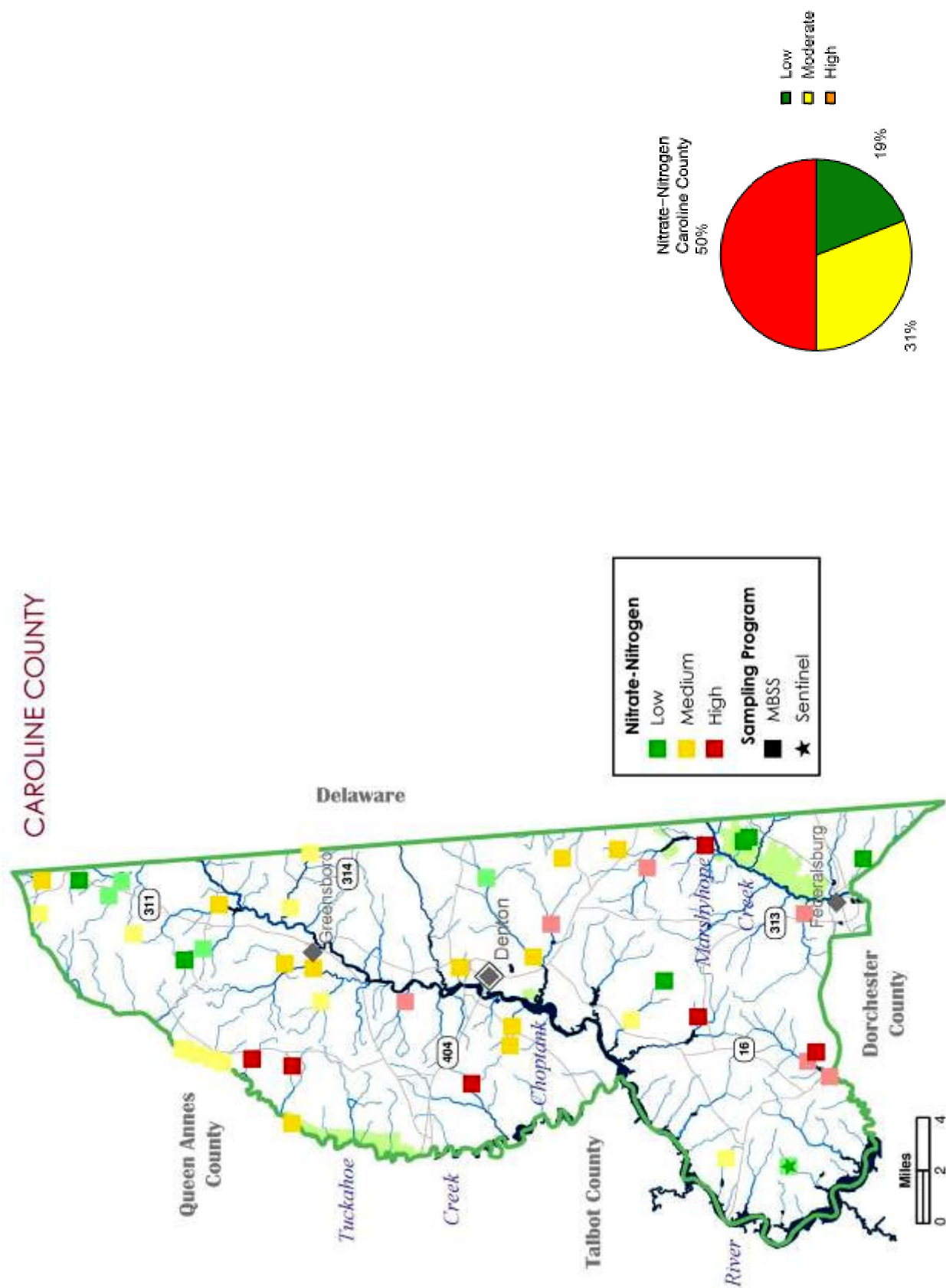


Figure 8-57. Pie chart and map of nitrate-nitrogen values (mg/l) for Caroline County streams sampled by the MBSS during 1995-97 and 2000-2004 (pie charts represent 2000-2004 data only) (Low = 1.0, Medium = 1.0 – 5.0, High = > 5.0)

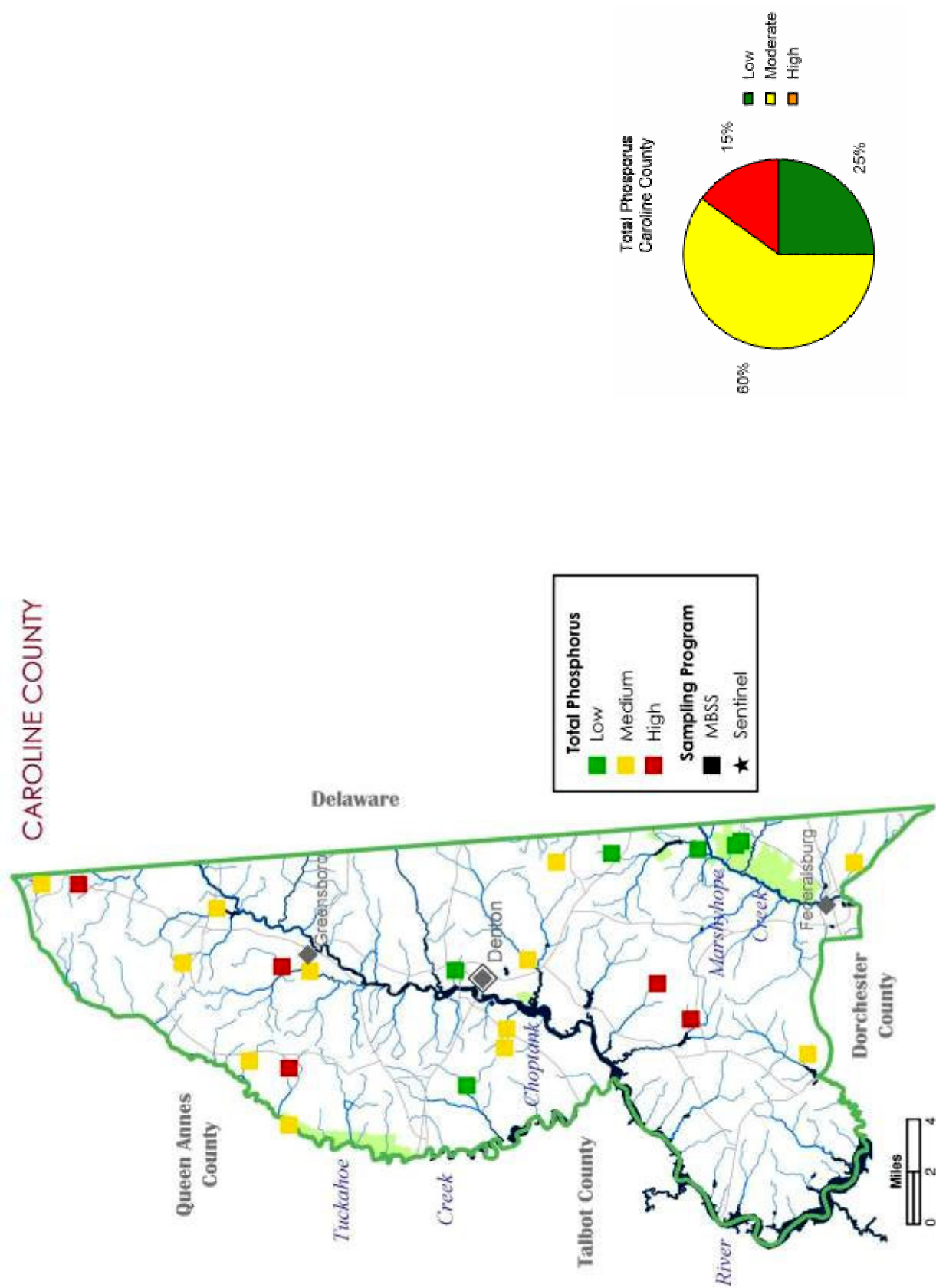


Figure 8-58. Pie chart and map of total phosphorus values (mg/l) for Caroline County streams sampled by the MBSS during 2000-2004 (Low = < 0.025, Medium = 0.025 – 0.07, High = > 0.07)

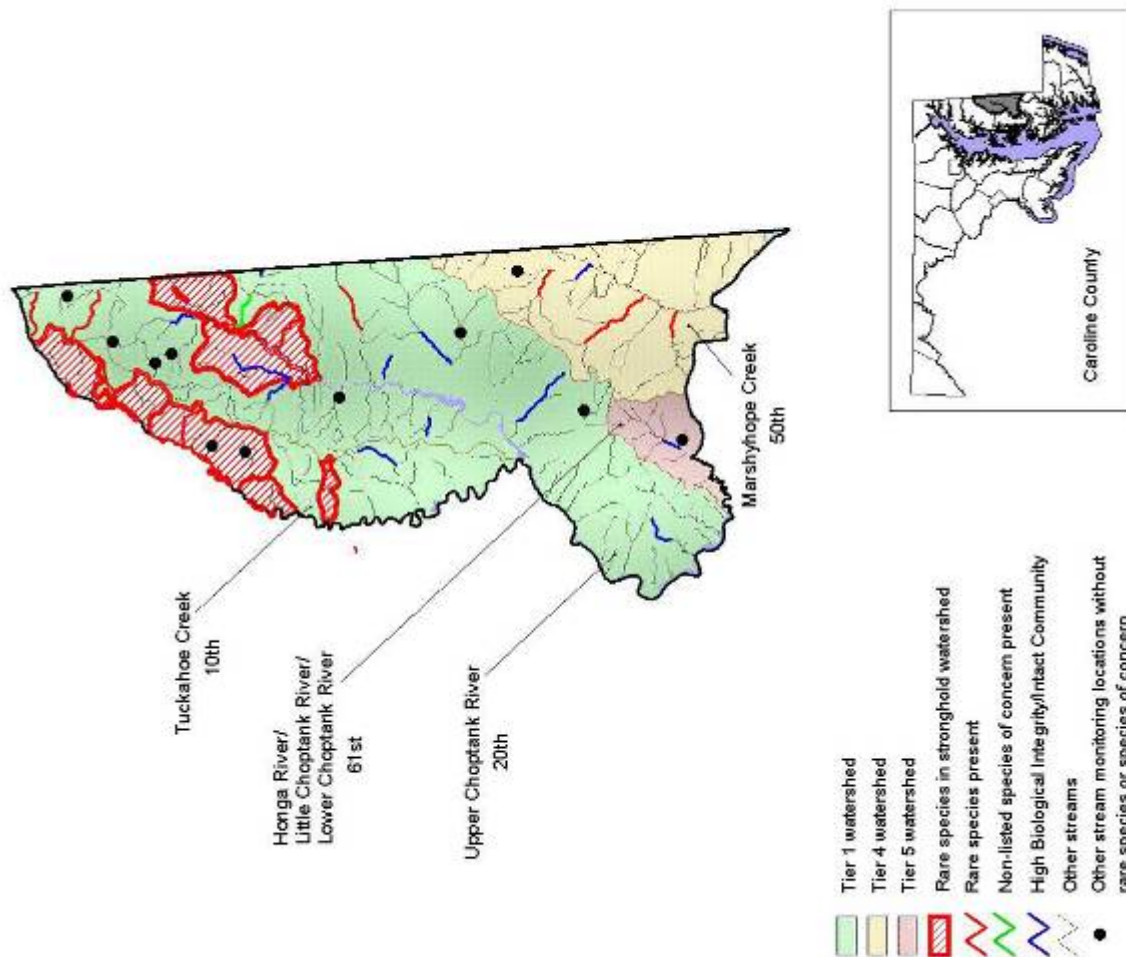


Figure 8-59. Aquatic Heritage Biodiversity Ranking map for Caroline County, by watershed. Data from MBSS 1994-2004, MBSS qualitative data, Raesly, unpub. data, Harris 1975, Thompson 1984, and DNR Natural Heritage Program database.



